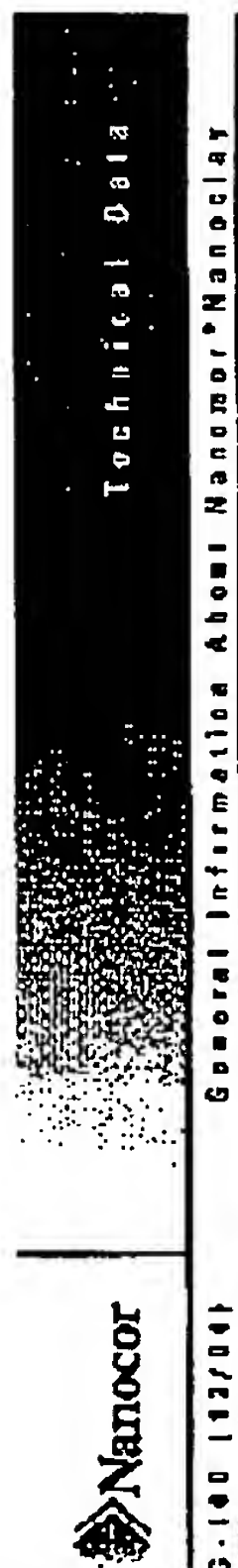


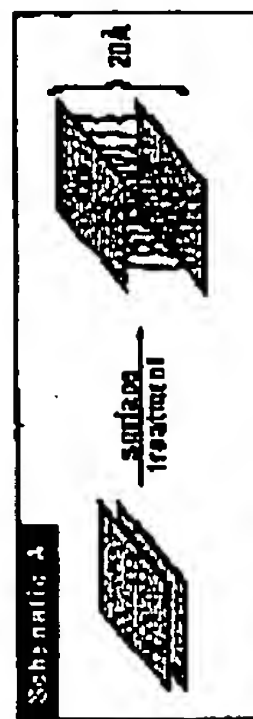
## Attachment E



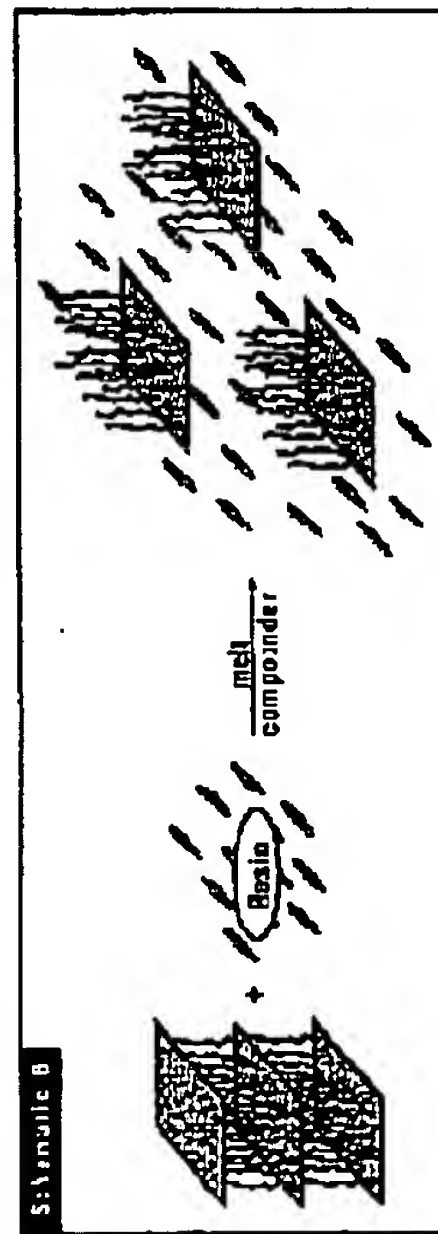
Nanocor® Nanoclays are montmorillonite minerals which have been treated with compatibilizing agents, enabling them to disperse to nanoscale size in plastic resins. Montmorillonite's unique atomic structure allows it to be modified with organic groups, which are responsible for its unique properties. When the organic groups are modified using surface treatment, each particle can disperse to its naturally occurring nanoscale size.

#### Surface Treatment:

Nanocor uses patented surface treatment technology. As schematically illustrated, montmorillonite particles are impregnated to within a distance of about 0.3A. Surface treatment reduces particle particle attraction, promoting an expansion of the distance (width) to above 20A. As this distance the particles can be separated (either by shearing forces or by an external compound).



Schematic B depicts the case where dispersion occurs in the compounding operation. Complete dispersion is called "exfoliation." When Nanocor® is exfoliated in a resin matrix, the result is a nanocomposite.



#### Morphology of Exfoliated Nanocor:

In exfoliated form, Nanocor particles have a double sheet-type structure which is remarkable for its very small size, especially the thickness of the sheet. The length and breadth of the particles ranges from 1.5 microns down to a few microns of a micron. However, the thickness is astonishingly small, measuring only about a nanometer in thickness of a meter. These dimensions result in extremely high surface area (200 - 360). Moreover, the thin scale size and thickness mean that a single layer contains over a trillion individual particles.

#### How Nanoclays Work:

Composite products are well aware of the benefits of high aspect ratio fillers. But only recently have science and industry discovered the magnifying effect of combining aspect ratio and nanoscale size. Because nanoscale-sized particles approach the scale of resin molecules, a very close encounter can be made between the two materials when the interface is properly surface modified. The particle-molecule interaction creates a constrained region at the particle surface, which limits the diffusion of the resin matrix. With summary particles available for interaction, association of the cumulative presence of constrained polymer can become large. In other resin systems, for example, the constrained region exceeds 50% of the total matrix.

#### Nanocor Nanoclays in Reinforcement:

The rates of mechanical properties versus filler loading is high for nanocomposites. As a result, loading can double flexural modulus and heat distortion with minimal loss in toughness. In some systems the glass transition temperature can be increased 10-20°C. Nanocomposites are amenable to combination reinforcement with other common fillers such as glass fiber. The composite designer has greater flexibility in making resins strong but lighter since the strength of the composite is reduced by such an effective reinforcement.

#### Nanocor Nanoclays in Barrier Enhancement:

Gas barrier can increase dramatically depending on the resin. Exfoliated Nanocor particles are not only extremely small but also flexible. They will orient in the direction of extrusion. Filled extruded materials because the wavelength of visible light exceeds the thickness of Nanocor particles. Gas permeability can be reduced by 30%-50% using as little as 3% weight Nanocor. Although Nanocor Nanoclay's purity is very low, it minimizes elongation loss. It will vary with loading level, degree of exfoliation and host resin.

For more information on how Nanocor® nanoclays can work for you, contact Nanocor's Technical Service Group. Nanocor is a registered trademark of Nanocor, Inc.



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